AMR center and web data publishing

Weather module "MTM-PV"

Field bus RS485

Communication via GSM/GPRS/ADSL

"E2M-PV" module for the inverter generated energy metering (AC side)

Local interface (PC notebook) option

Pannelli PV

Inverter

"DCM-PV" module for DC electric measurements

AC 50 Hz power grid (monophase or triphase)

Loads

E2M meter to measure the AC energy exchanged with power network (option)

Automated meter management and data analysis for photovoltaic and cogeneration monitoring systems

Overview

IesWebPV is an application system expressly designed for enterprise class "vendor independent" systems in the field of energy monitoring of photovoltaic and cogeneration plants: conceived for scalable hardware architectures according to real system extension, it allows the automated management of a complex network of electric energy meters and weather stations, both in local and in geographic area networks. A suite of web-based IesWebPV software modules offers sophisticated functions for electric energy and power quality data analysis.

IesWebPV is the perfect tool for the energy-managers to manage multiple plants, to compute the generated and consumed energy in PV or cogeneration plants, to check the real efficiency of plants, to discover anomalies in generation processes (energy stealing, faults or degradation of equipment), to forecast the energy budgets for trading operators.

Peripheral modules:

E2M-PV Module: unit for measurement and recording of electrical quantities on LV and MV single e three-phase lines

General features
The E2M-PV module includes a class 1 bidirectional smart-meter to measure and record the electric quantities on the LV/MV power network, according to standard IEC 62052.

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E2M-PV module is available in 2 versions: one for direct connection on LV lines up 60A, one for semi direct connection through external CT, suitable for higher currents.
For MV networks, E2M-PV module can be equipped with an interface for reading fiscal meters (ES module) and it's available in the indirect connection version (through CT and VT).

E2M-PV is equipped with multiple communication interfaces (GSM/GPRS, Ethernet/ADSL) making it suitable for remote monitoring networks. It also has a RS485 bus for connections to other local measuring units (DC measures, weather measures) or intelligent devices (inverters, local controls, switch panels PLC, etc.).

E2M-PV is arranged in an IP65 plastic enclosure, with door key and sealed cable glands for outdoor usage. The module is equipped with support terminal blocks for simple wiring to the AC power network and the inverters. Also, it is designed to accept protections against overvoltages occurring on the power network and the field bus.

E2M-PV also has a backup battery, to ensure the possibility of sending alarm signals even in network absence conditions.

Functions

- Measure and recording of power profiles (with programmable rate, from 1 minute to 1 hour) and of the energy daily and monthly produced and consumed by the photovoltaic plant, class 1 according to IEC 62052 (AC side) .
- Recording of voltage, current and power measures on DC side received from DC modules (at same rate of AC measures; in case of multi-array plants it is possible to connect up to 6 modules).
- Recording of weather data coming from weather module (sun radiation over the PV panels, sun radiation over the horizontal plane, PV panel temperature, air temperature, wind speed) at same rate of AC measures.
- Alarm signaling (with a sms) when no power generation is detected even with the presence of a valuable sun radiation.
- Clock calendar with daylight saving time according to UE standard.

- External GPS receiver to sync the time base and to correlate the photovoltaic generated energy together with the positional information (option).
- Remote communication with central system based on IP protocols (Modbus over TCP) via GSM / GPRS modem or ADSL internet router.
- Local communication with a PC for configuration and diagnostic.
- Direct link with the plant inverters to collect anomalies and fault alarms (optional function, requiring specific protocol drivers for each inverter models).
- Self-diagnostic to supervise the device operations and the data storage integrity.
- Remote firmware upgrade to add new specific features.

Technical specifications

- 3 voltage inputs with common neutral (Vn: 3 x 230 Vac phase-neutral).
- 3 insulated current channels for direct connection (up to 60A, Ib = 10A) or for semi direct and indirect insertion with external CT (Ib = 5A).
- LCD display.
- Two pushbuttons for pages scrolling and menu navigation.
- Embedded GSM/GPRS modem.
- Arrangement for mounting an external high gain directional antenna, for installation in area with low mobile signal strength.
- Two pulse emitting leds for energy metering certification.
- 1 RS485 field-bus for communication with plant modules (weather data, DC measures).
- 1 RS232/RS485 communication port for local connection to PC or IED (ex. inverter).
- 1 Ethernet 10/100baseT communication port for local PC and/or router connection.
- 1 RS485 communication port to connect to a GPS (geographical localization and time synchronization).
- Nonvolatile clock calendar (accuracy ±1 minute/month).
- Configurable digital inputs and outputs for alarms and/or local signaling.
- 1 MB nonvolatile memory for data storage (2 months recording buffer and recording rate of 15 minutes).
- 230 Vac power supply
- 2 integrated 12 Vdc power supplies for other field modules with fuse terminal blocks.
- Backup battery 12V - 0.8Ah
- Arrangement for overvoltages suppressors (varistor or gas type suppressors) both on AC and field bus sides.
- Plastic enclosure IP65 30x50x20 cm, with door key and sealed cable glands.

DCM-PV Module: unit for measurement and recording of DC side quantities
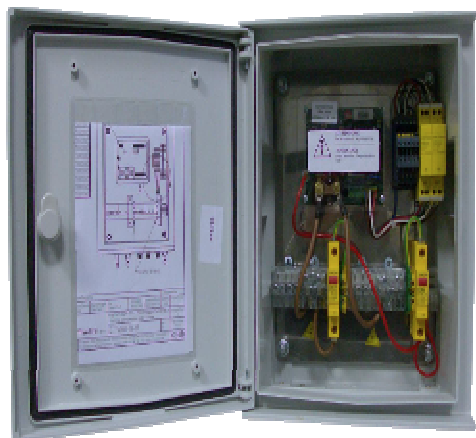
General features

The DCM-PV module is installed upstream of the inverter to measure the DC quantities produced by the photovoltaic panels:

- DC current from PV strings (30 A max) **
- DC voltage from PV strings (600 V max) **
- DC power from PV strings (18 kW max)

DCM-PV is directly connected to the DC bus coming from PV strings by mean of connectors (option: specific field connectors (i.e. type MC4)).

DCM-PV is arranged in IP65 enclosure, with key door. It is powered directly by E2M-PV module, which is connected to via a RS485 bus over Modbus RTU protocol.

In case of multi-string inverters or plants with multiple inverters, it's necessary to install more than one DCM-PV module: the E2M-PV recording module can manage up to 6 distinct DCM-PV modules.

Technical specifications

- 1 voltage DC channel (20 ÷ 600 Vdc max) **
- 1 current DC channel (50mA ÷ 30 Adc max) **
- Accuracy: class 1.
- Measure processing: average on 10 seconds intervals.
- Protocol: ModBus RTU.
- RS485 field bus terminal blocks with independent input and output blocks.
- Independent overvoltage suppressors for positive and negative DC rails from PV panels.
- Overvoltage suppressor independent for field bus.
- Supply voltage: 12 Vdc from E2M-PV module.
- Plastic enclosure IP65 30x35x20 cm, with door key and sealed cable glands.

** On request, models with different current and voltage range can be assembled.

Modulo MTM-PV: unit for measurement and recording of weather quantities

General features

MTM-PV weather module can perform these measures:

- Sun radiation from external silicon cell positioned on the same plane of PV panels (range 0 ÷ 1500 W/m^2).
- Sun radiation from external silicon cell positioned on horizontal plane (range 0 ÷ 1500 W/m^2).
- Temperature of PV panel, from digital probe located behind the panel (range -40 °C ÷ +100 °C).
- Environment temperature from digital probe (range -40 °C ÷ +70 °C).
- Wind speed (50 m/s max) from external digital pulse anemometer.

The weather module MTM-PV is installed near to the PV plant to ensure valid signals not corrupted from EMC disturbances.

To guarantee high accuracy in sun radiation measurement, it is possible to preset the module with the calibration parameters of the used reference cell.

The module is arranged in an IP66 enclosure. It is powered directly by E2M-PV module, which is connected to via a RS485 bus over Modbus RTU protocol.

The E2M-PV module is able to manage up to two distinct MTM-PV modules.

The environment and panel probes are supplied with the MTM-PV module, while the other probes (cell irradiation, pyranometer, and anemometer) are to be required.

Technical specifications

- 1 voltage channel 0 ÷ 60 mV for calibrated sun radiation cell positioned on the same plane of PV panels (cell not included).
- 1 voltage channel 0 ÷ 60 mV for calibrated sun radiation cell positioned on horizontal plane (cell not included).
- 1 temperature input from digital temperature probe for panel temperature (range -40°C ÷ +100°C) (probe included).
- 1 temperature input from digital temperature probe for air temperature (range -40°C ÷ +70°C) (probe included).
- 1 pulse input channel for anemometer (anemometer not included).
- Accuracy: class 1 for all the quantities.
- Average measures over 10 sec. interval.
- RS485 field bus terminal blocks with independent input and output blocks (daisy chain)
- Overvoltage suppressors for all inputs.
- Power supply: 12 Vdc from E2M-PV module.
- Plastic enclosure IP66 30x20x10 cm, with sealed cable glands.

DIM-PV & DOM-PV Modules: modules for digital input and output management

The DIM-PV and DOM-PV digital I/O modules allow to capture signals from the plant (e.g. status switches, alarms, inverters, etc.) and to perform remote controls.

Modules are arranged in an enclosure suitable for DIN bar mounting and supply themselves directly from the field bus that connects them to E2M-PV module, which they communicate with through Modbus protocol. It's possible to install on the same field bus up to 8 digital I/O modules, in addition to the other modules for DC quantities and weather measurements.

Technical specifications

- DIM-PV: 8 digital inputs by dry contact
- DOM-PV: 8 open collector digital outputs, 30 Vdc – 10 mA
- Extractable input/output terminal block
- RS485 field bus terminal block with independent input and output terminals.
- Power supply: 12 Vdc directly from E2M-PV Module
- Plastic enclosure opening from DIN bar.

SCOM: Wireless communication module 2.4 GHz

SCOM module functions as a wireless bridge among field modules of IesWebPV system. It allows to realize wireless connections among devices that communicate with the RS485 standard, allowing to avoid wired connections where they can be difficult to set up.

SCOM modules scope is about 100 mts. in open space.

For the realization of completely wireless solutions, SCOM-PV module is available. It supplies itself directly from PV plant, providing also the backup battery charge and the measure modules power supply.

AMR Center and data web publishing

Architecture

- One or more Communication Server for the management of communication with peripheral devices and data collection.

- A Database Server where the configuration parameters for each peripheral device and the measured data received from the field reside. This database operates also as web application back-end for the data analysis.

- A communication infrastructure in order to establish a GPRS / GSM / ISDN / PSTN communication toward the peripheral devices. Such network in small-medium systems will be composed by a series of local modems or communication cards, while for enterprise class installations it will be directly wired on the Intranet / Internet LAN.

- A Web Server for the management of the data analysis web application.
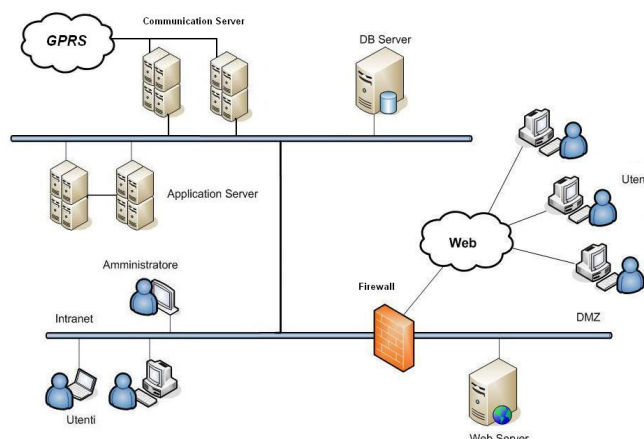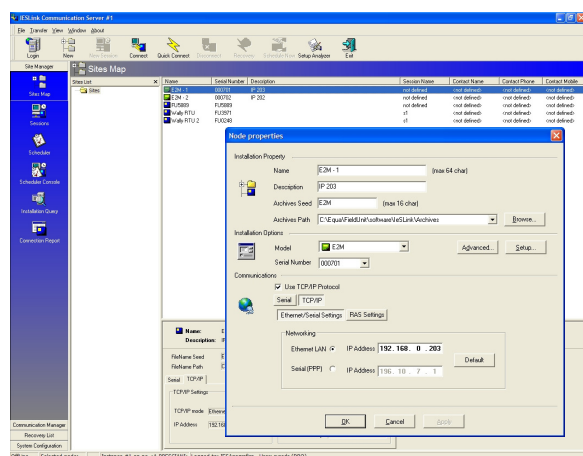
- Thin-clients running a web browser to allow the end-users to connect via Intranet or Internet to IesWeb website in order to make the energy and power-quality analysis

Software platform
- Communication Server: Microsoft Windows XP Professional, Vista, 7, or Microsoft Windows Server
- Database Server: Microsoft Windows Server
- RDBMS: Microsoft SQL Server
- Web Server: Microsoft IIS

- Smart recovery of failed connections.

- User profiling, with dynamic association between devices and users.

- Service facilities (statistics over communications, site-map reports, user preferences, etc.).

- TCP/IP based protocols over Ethernet / GPRS / GSM / ISDN / PSTN links.

- Access to peripheral devices protected by username/password authentication.
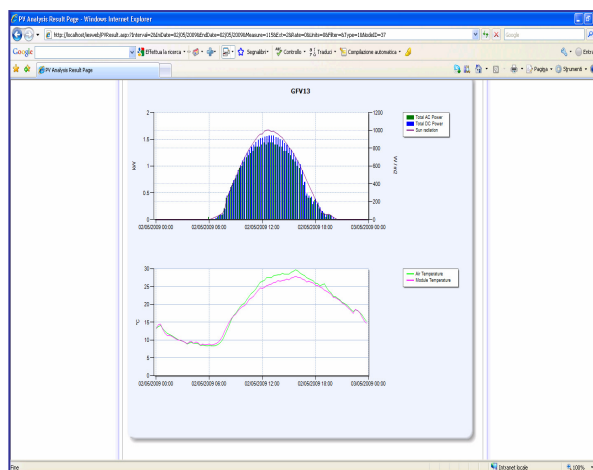
Software Modules

IesLink – Communication Manager

- E2M peripherals network configuration: for each device it's possible to define the site identification parameters, the operating and recording parameters, the communication parameters.

- Direct on-demand connection with any E2M-PV peripheral device, to show real-time measures (AC, DC and weather) and status, sending configuration parameters and receiving measures.

- Automatic reading jobs, for measures collecting from E2M-PV peripheral devices, with flexible setup of time schedules, type of measures to read, configuration parameters to send.

- Remote upgrade of application firmware of peripheral modules, without suspending the normal operations.
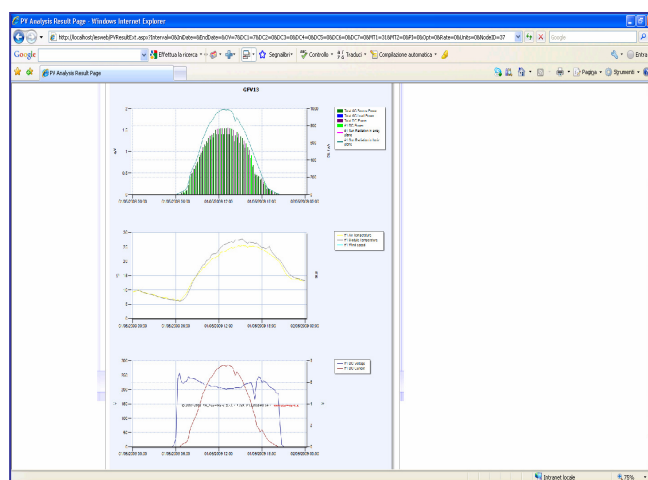
IesWeb - Web Application

- **Photovoltaic data analysis:**
  - Profile of total energy produced and consumed upward (DC) and downward (AC) the inverter.
  - Profile of energy generated by single PV strings and subfields
  - Profile of sun radiation on horizontal and panel planes.
  - Profile of air and panel modules temperature and of wind speed.

  - Yield coefficients:
    - panels yield (Ya)
    - overall plant yield (Yf)
    - reference yield (Yr)
    - performance ratio (PR)
    - inverter efficiency (ηi)

  - Data export in xls, pdf, csv formats.

- **Energy data analysis:**
  - Total and tariff-divided production / consumption.
  - Detail of daily / weekly / monthly production / consumption, both total and tariff- divided.
  - Compute of differential consumption shift among different sites, as absolute and percentage value, in order to discover sites having abnormal production or consumption compared to expected average values.
  - Load profile at the integration time (typically 15 minutes).
  - Evaluation of weekly load profile at the integration time for each site, based on historical consumption data, to optimize the supply contracts and the forecast for the energy buyers.
  - Maximum demands assessment.

- **Power quality data analysis:**
  - Short interruptions list report (timestamp and duration)
  - Long interruptions list report (timestamp and duration)
  - Total cumulative time with voltage over the contract level
  - Total cumulative time with voltage below the contract level
  - Peak voltage and current values detected
  - Lowest voltage and current values detected

- User **queries** to easily find out the most interesting installations (search for sites having highest or lowest consumptions, having consumption higher or lower than a specified amount, having highest consumption variation compared to a reference period, etc.).

- Defining of parameters to allow a **normalized analysis** of measured sites, in order to make an immediate comparison among installations even if they differ for known quantitative issues (e.g. size, number of employees, etc.), without needing a supplementary offline post processing by the user.

- Scheduling for **automatic sending** by email of periodic reports, without any further operation requests.

- **Site administration tools:**
  - User management: user creation, user delete, role assignment (administrator, power user, visitor), notifications sending via email.
  - User-installation relationship configurable, in order to restrict for each user the visibility of installations to a specific subset (for multi independent customers management).
  - Website maintenance: off-line/on-line site switch, home-page banner with editable user message (e.g. "site momentarily non available").

IesWeb-PV: example screenshots